What is claimed is:

1. A method of generating a reconstructed 2D image of a 3D scan volume $f(x,y,z)$ of an object, for an orientation $(\theta, \phi, \varphi)$ of the 3D scan volume $f(x,y,z)$, the method comprising:

a. generating 3D scan data representative of the 3D scan volume $f(x,y,z)$ of said object;

b. computing a 3D Fourier transform $F(u,v,w)$ of the 3D scan volume $f(x,y,z)$, wherein u,v, and w are variables in a three-dimensional frequency domain;

c. sampling a surface $S(\theta, \phi, \varphi, u', v')$ within said 3D Fourier transform $F(u,v,w)$, at angles $(\theta, \phi, \varphi)$ corresponding to said orientation of said 3D scan volume;

and

d. computing the 2D inverse Fourier transform $F^{-1}[S(\theta, \phi, \varphi, u', v')]$ of said surface $S(\theta, \phi, \varphi, u', v')$.

2. A method in accordance with claim 1, wherein the reconstructed 2D image comprises a DRR (digitally reconstructed radiograph).

3. A method in accordance with claim 2, wherein $F^{-1}$ $[S(\theta, \phi, \varphi, u', v')]$ is a 2D DRR reconstructed along a projection direction perpendicular to said surface $S(\theta, \phi, \varphi, u', v')$.

4. A method in accordance with claim 3,

wherein the projection direction comprises a direction of a cone projection, the cone projection being the projection of a beam originating from a point source, passing through the scan volume, and incident upon a planar 2D surface;

wherein said 2D DRR represents the radiographic image of the scan volume that would be obtained with an imaging beam emitted from a point source disposed at a known position and angle, if said scan volume were positioned in accordance with said 3D scan data; and

wherein the step of sampling said surface $S(\theta, \phi, \varphi, u', v')$ within said Fourier transform $F(u,v,w)$ comprises the step of selecting the sampling surface in a way that the sampled surface is part of the surface of a sphere whose center is coincident with said point source.

5. A method in accordance with claim 1, wherein said 3D scan data comprise at least one of: CT scan data, PET (positron emission tomography) scan data, MRI (magnetic resonance imaging) scan data, and ultrasound scan data.

6. A method in accordance with claim 1, wherein sampling in part c said surface $S(\theta, \phi, \varphi, u', v')$ at angles $(\theta, \phi, \varphi)$ comprises selecting a 3D resampling kernel.

7. A method in accordance with claim 6, wherein said 3D resampling kernel comprises at least one of: a bi-linear kernel, a tri-linear kernel, and a bi-sinc kernel.

8. A method in accordance with claim 1, wherein the step of sampling said surface $S(\theta, \phi, \varphi, u', v')$ comprises the step of selecting a sub-volume around an origin for resampling, when sampling said surface $S(\theta, \phi, \varphi, u', v')$ in part c.

9. A method in accordance with claim 1, further comprising padding said sample surface $S(\theta, \phi, \varphi, u', v')$ with zeros, after sampling said surface $S(\theta, \phi, \varphi, u', v')$ in part c.

10. A method in accordance with claim 1, further comprising applying a convolution filter to said sample surface $S(\theta, \phi, \varphi, u', v')$, by multiplying said sample surface with a 2D fast Fourier Transform of said convolution filter.

11. A method in accordance with claim 1,
wherein said 3D scan volume is characterized by spatial dimensions given by (M*N*P), and wherein said reconstructed 2D image and said sampling surface are characterized

by spatial dimensions given by (M*N).

12. A method in accordance with claim 1, wherein said Fourier transform F(u,v,w) is represented mathematically by:

$$F(u,v,w) = \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} f(x,y,z)\, e^{-2\pi j(ux+vy+wz)} dx\, dy\, dz.$$

13. A method of generating a 2D DRR (digitally reconstructed radiograph) of a 3D scan volume f(x,y,z) of an object from 3D scan data representative of said 3D scan volume, for an orientation ($\theta$, $\phi$, $\varphi$) of said 3D scan volume, the method comprising:

a. generating a 3D data set in frequency space representative of the 3D Fourier transform F(u,v,w) of said 3D scan volume f(x,y,z);

b. resampling said 3D F(u,v,w) data set along a surface S($\theta$, $\phi$, $\varphi$, u', v') within said data set, said surface passing through the origin of said 3D data set and being defined by angles ($\theta$, $\phi$, $\varphi$) corresponding to said orientation of said 3D scan volume;

and

c. computing the 2D inverse Fourier transform $F^{-1}$[S($\theta$, $\phi$, $\varphi$, u', v')] of said surface S($\theta$, $\phi$, $\varphi$, u', v') to generate a DRR along a projection direction perpendicular to said surface S($\theta$, $\phi$, $\varphi$, u', v').

14. A method in accordance with claim 13, wherein resampling along said surface S($\theta$, $\phi$, $\varphi$, u', v') comprises assigning, to each pixel along said surface in said 3D data set representative of F(u,v,w), the value of the closest neighboring pixel.

15. A method in accordance with claim 13, wherein resampling along said surface S($\theta$, $\phi$, $\varphi$, u', v') comprises:

a) selecting a resampling kernel;

b) for each data point along said surface, multiplying one or more neighboring pixel values with the resampling kernel value at the sample point, and

c) adding together the multiplied values to form the resampled pixel value.

16. A method in accordance with claim 13, wherein said resampling kernel comprises at least one of:

a. a bi-linear resampling kernel;

b. a tri-linear resampling kernel;

c. a sinc resampling kernel; and

d. a bi-sinc resampling kernel.

17. A method in accordance with claim 13, wherein resampling along said surface $S(\theta, \phi, \varphi, u', v')$ comprises padding said surface with zeros.

18. A method in accordance with claim 13, wherein resampling along said surface $S(\theta, \phi, \varphi, u', v')$ comprises multiplying said surface with a 2D Fourier transform of a convolution filter.

19. A system for generating a reconstructed 2D image of an object representative of a 3D scan volume $f(x,y,z)$ of the object, for an orientation $(\theta, \phi, \varphi)$ of said 3D scan volume, the system comprising:

a. a scanner configured to provide 3D scan data representative of said 3D scan volume $f(x,y,z)$;

b. a controller, including:

i. an input module configured to receive said 3D scan data;

ii. a first processor configured to generate a 3D data set representative of a 3D Fourier transform $F(u,v,w)$ of said 3D scan volume $f(x,y,z)$, where u, v, and w represent variables along three mutually orthogonal coordinate axes in the frequency domain;

iii. resampling means for resampling said 3D data set along a surface $S(\theta, \phi, \varphi, u', v')$, said surface $S(\theta, \phi, \varphi, u', v')$ being defined at angles $(\theta, \phi, \varphi)$ corresponding to said orientation of said 3D scan volume; and

iv. a second processor configured to compute a 2D inverse Fourier transform $F^{-1}$ [$S(\theta, \phi, \varphi, u', v')$] of said surface $S(\theta, \phi, \varphi, u', v')$.

20. A system in accordance with claim 19, wherein said scanner comprises at least one of: a CT scanner; a PET scanner; an MRI scanner; and an ultrasound scanner.

21. A system in accordance with claim 19, wherein said reconstructed 2D image comprises a DRR (digitally reconstructed radiograph).

22. A system in accordance with claim 19, wherein said 2D inverse Fourier transform $F^{-1}$[$S(\theta, \phi, \varphi, u', v')$] is a 2D DRR reconstructed along projection direction that is perpendicular to said surface $S(\theta, \phi, \varphi, u', v')$.

23. A system in accordance with claim 22,

wherein said projection direction comprises a direction of a cone projection, the cone projection being the projection of a beam originating from a point source and passing through said scan volume and incident upon a planar 2D surface;

wherein said 2D DRR represents the radiographic image of said scan volume that would be obtained with an imaging beam emitted from a point source disposed at a known position and angle, if said scan volume were positioned in accordance with said 3D scan data; and

wherein said means for sampling said surface $S(\theta, \phi, \varphi, u', v')$ comprises means for selecting a sampled surface that is part of the surface of a sphere whose center is coincident with said point source.

24. A system in accordance with claim 19, wherein said means for resampling said surface $S(\theta, \phi, \varphi, u', v')$ comprise means for selecting a 3D resampling kernel.

25. A system in accordance with claim 19, wherein said 3D resampling kernel

comprises at least one of: a bi-linear kernel, a tri-linear kernel, and a bi-sinc kernel.

26. A system in accordance with claim 19, wherein said means for sampling said surface $S(\theta, \phi, \varphi, u', v')$ comprise means for selecting a sub-volume around an origin for resampling.

27. A system in accordance with claim 19, wherein said 3D scan volume is characterized by spatial dimensions (M*N*P),
and wherein said reconstructed 2D image and said sampling surface are characterized by spatial dimensions (M*N).

28. A system in accordance with claim 19, wherein said resampling means comprise:
a. means for multiplying, for each data point along said surface, one or more neighboring pixel values with the value of a resampling kernel at said data point; and
b. means for summing said multiplied values to form a resampled pixel value.

29. A system for generating a DRR of a 3D scan volume f(x,y,z) of an object, for an orientation $(\theta, \phi, \varphi)$ of said 3D scan volume, from 3D scan data representative of said volume f(x,y,z), the system comprising:
A. a controller, including:
a. an input module configured to receive said 3D scan data;
b. a first processor configured to compute a 3D data set in frequency space representative of Fourier transform F(u,v,w) of said 3D scan volume f(x,y,z), where u, v, and w represent variables along three mutually orthogonal coordinate axes in the frequency domain;
c. resampling means for resampling said 3D data set along a surface $S(\theta, \phi, \varphi, u', v')$, said surface $S(\theta, \phi, \varphi, u', v')$ passing through the origin and being defined at angles $(\theta, \phi, \varphi)$ corresponding to said orientation of said 3D scan volume; and

d. a second processor configured to compute a 2D inverse Fourier transform $F^{-1}$ [S(θ, ϕ, φ, u', v')] of said surface S(θ, ϕ, φ, u', v');

wherein said 2D inverse transform $F^{-1}$ [S(θ, ϕ, φ, u', v')] is a DRR along a projection direction perpendicular to said surface S(θ, ϕ, φ, u', v').